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BOOK OF ABSTRACTS

Investigation of frequency of dielectric relaxation of water molecules in blood cells of cancer patients

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To determine the causes and specific mechanisms of disruption of biochemical, physiological and other processes in the irradiated body, it is necessary to study post-radiation changes in the structure and functioning of cells [Int. J. Biosen. Bioelectron. 2018;4(6):242-247]. The paper presents the results of a biophysical study of the frequency of dielectric relaxation (f_d) of water molecules in blood cells (erythrocytes) of breast cancer patients (n = 32), under conditions of radiation exposure to the tumor (a single focal dose was 6 Gy), which were obtained for using the method of microwave dielectrometry, at a frequency of 9.2 GHz [AS Cancer Biology. 2018; 2(10):55-60]. The value of the real part of the dielectric permittivity (ε') was determined by the change in the resonant frequency of the resonator with the sample relative to the empty resonator, and the imaginary part of the dielectric permittivity (ε'') was determined by the magnitude of the attenuation of the microwave field power due to the introduction of a dielectric into the resonator. The temperature of the test sample was recorded with an accuracy of ± 0.1 °C. Blood from healthy donors was used as a control (n = 30). Statistical processing of the obtained data was performed using the MATLAB program and Mann-Whitney nonparametric test.

For the real and imaginary parts of the complex dielectric permittivity and the frequency of dielectric relaxation of water molecules in the suspensions of erythrocytes of donors and patients dependences on the range temperature of 2-47 °C were obtained. The activation energy of the dielectric relaxation time of water molecules in the studied systems and the magnitude of the degree of hydration of the erythrocyte membranes of donors and patients before and after irradiation were calculated. It was found that at temperatures of 10-12 ° C, 20-23 ° C and 30-36 ° C structural changes of erythrocyte membranes of donors and patients with malignant neoplasms are observed, which are accompanied by changes in activation energy. The increase in activation energy in the range of 8-12 ° C, the frequency of dielectric relaxation of water molecules in erythrocyte membranes of patients may be associated with a global structural transition in cell membranes, which affects both peripheral proteins of the cytoskeletal complex and integral proteins of membrane 3, in particular membrane proteins [2018 IEEE 8th International Conference Nanomaterials: Application & Properties (NAP)]. It is established that radiation therapy approximates the value of the frequency of dielectric relaxation (f_d) of water molecules in suspensions of erythrocytes of patients to the indicators of healthy donors. The breakpoints of the Arrhenius dependency diagrams lie in the range of temperatures known as critical, in which the velocities of many physiological processes associated with erythrocyte membranes change.